TSN Profile for Service Provider Networks

Tongtong Wang
Norman Finn
Xinyuan Wang

HUAWEI TECHNOLOGIES CO., LTD.

Project Authorization Request (PAR) – Draft

- **2.1 Title**: Time-Sensitive Networking for Service Provider Networks
- **4.3 Projected Completion Date for Submittal to RevCom**: 0？/2021
- **5.2 Scope**: This standard defines profiles that select features, options, configurations, defaults, protocols and procedures of bridges, stations and LANs that are necessary to build networks that provide Time-Sensitive Network quality of service features for shared service provider networks.

- **5.4 Purpose**: This standard provides guidance for designers and implementers of service provider networks, to be shared by some number of applications, who need the Quality of Service features offered by IEEE Std 802.1Q bridges, including dependable bandwidth and latency promise.

Draft PAR – cont'd

- **5.5 Need for the Project**: 5G transport networks will have an order of magnitude more cells than present networks, making it essential for multiple carriers to share a physical infrastructure. This sharing is sometimes called "network slicing". QoS partitioning between customers will enable high-value services that have stringent bandwidth and latency requirements, to efficiently share the network with best-effort services.

- **8.1 Additional Explanatory Notes:**

Thank you

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Use Cases

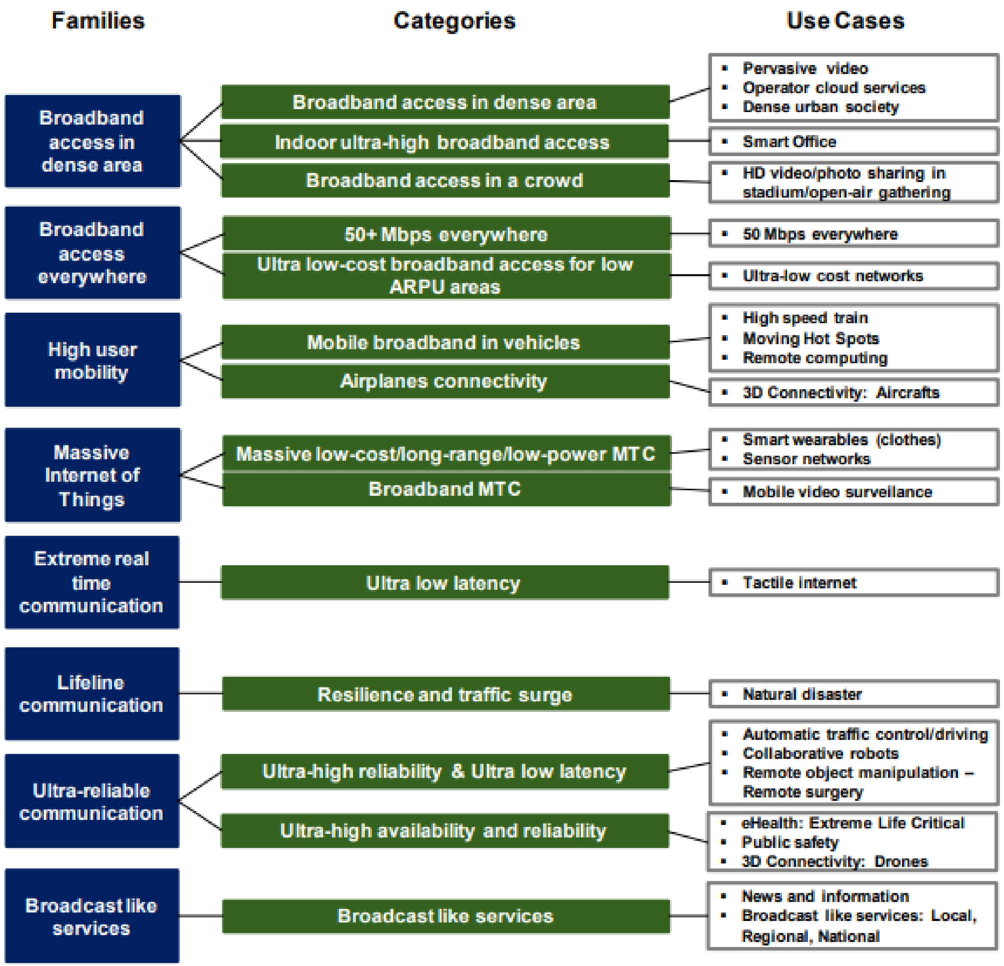

Figure 5: Use case categories definition

Think about supporting multiple use cases over a single physical network.

** From NGMN 5G white paper*

3GPP TS 22.261: high data rate and traffic density scenarios

	Scenario	Experienced data rate (DL)	Experienced data rate (UL)	Area traffic capacity (DL)	Area traffic capacity (UL)	Overall user density	Activity factor	UE speed	Coverage
1	Urban macro	50 Mbps	25 Mbps	100 Gbps/km² (note 4)	50 Gbps/km² (note 4)	10 000/km²	20%	Pedestrians and users in vehicles (up to 120 km/h	Full network (note 1)
2	Rural macro	50 Mbps	25 Mbps	1 Gbps/km² (note 4)	500 Mbps/km² (note 4)	100/km²	20%	Pedestrians and users in vehicles (up to 120 km/h	Full network (note 1)
3	Indoor hotspot	1 Gbps	500 Mbps	15 Tbps/km²	2 Tbps/km²	250 000/km²	note 2	Pedestrians	Office and residential (note 2) (note 3)
4	Broadband access in a crowd	25 Mbps	50 Mbps	[3,75] Tbps/km²	[7,5] Tbps/km²	[500 000]/km²	30%	Pedestrians	Confined area
5	Dense urban	300 Mbps	50 Mbps	750 Gbps/km² (note 4)	125 Gbps/km² (note 4)	25 000/km²	10%	Pedestrians and users in vehicles (up to 60 km/h)	Downtown (note 1)
6	Broadcast-like services	Maximum 200 Mbps (per TV channel)	N/A or modest (e.g., 500 kbps per user)	N/A	N/A	[15] TV channels of [20 Mbps] on one carrier	N/A	Stationary users, pedestrians and users in vehicles (up to 500 km/h)	Full network (note 1)
7	High-speed train	50 Mbps	25 Mbps	15 Gbps/train	7,5 Gbps/train	1 000/train	30%	Users in trains (up to 500 km/h)	Along railways (note 1)
8	High-speed vehicle	50 Mbps	25 Mbps	[100] Gbps/km²	[50] Gbps/km²	4 000/km²	50%	Users in vehicles (up to 250 km/h)	Along roads (note 1)
9	Airplanes connectivity	15 Mbps	7,5 Mbps	1,2 Gbps/plane	600 Mbps/plane	400/plane	20%	Users in airplanes (up to 1 000 km/h)	(note 1)

NOTE 1: For users in vehicles, the UE can be connected to the network directly, or via an on-board moving base station.
NOTE 2: A certain traffic mix is assumed; only some users use services that require the highest data rates [2].
NOTE 3: For interactive audio and video services, for example, virtual meetings, the required two-way end-to-end latency (UL and DL) is 2-4 ms while the corresponding experienced data rate needs to be up to 8K 3D video [300 Mbps] in uplink and downlink.
NOTE 4: These values are derived based on overall user density. Detailed information can be found in [10].
NOTE 5: All the values in this table are targeted values and not strict requirements.

3GPP TS 22.261: low-latency and high-reliability scenarios

Scenario	End-to-end latency (note 3)	Jitter	Survival time	Communication service availability (note 4)	Reliability (note 4)	User experienced data rate	Payload size (note 5)	Traffic density (note 6)	Connection density (note 7)	Service area dimension (note 8)
Discrete automation – motion control (note 1)	**1 ms**	**1 µs**	0 ms	99,9999%	**99,9999%**	**1 Mbps up to 10 Mbps**	Small	1 Tbps/km^2	100 000/km^2	**100 x 100 x 30 m**
Discrete automation	**10 ms**	**100 µs**	0 ms	99,99%	**99,99%**	**10 Mbps**	Small to big	1 Tbps/km^2	100 000/km^2	1000 x 1000 x 30 m
Process automation – remote control	**50 ms**	**20 ms**	100 ms	99,9999%	**99,9999%**	**1 Mbps up to 100 Mbps**	Small to big	100 Gbps/km^2	1 000/km^2	300 x 300 x 50 m
Process automation – monitoring	**50 ms**	**20 ms**	100 ms	99,9%	**99,9%**	**1 Mbps**	Small	10 Gbps/km^2	10 000/km^2	300 x 300 x 50
Electricity distribution – medium voltage	**25 ms**	**25 ms**	25 ms	99,9%	**99,9%**	**10 Mbps**	Small to big	10 Gbps/km^2	1 000/km^2	100 km along power line
Electricity distribution – high voltage (note 2)	**5 ms**	**1 ms**	10 ms	99,9999%	**99,9999%**	**10 Mbps**	Small	100 Gbps/km^2	1 000/km^2 (note 9)	200 km along power line
Intelligent transport systems – infrastructure backhaul	**10 ms**	**20 ms**	100 ms	99,9999%	**99,9999%**	**10 Mbps**	Small to big	10 Gbps/km^2	1 000/km^2	2 km along a road
Tactile interaction (note 1)	**0,5 ms**	TBC	TBC	[99,999%]	**[99,999%]**	**[Low]**	[Small]	[Low]	[Low]	**TBC**
Remote control	**[5 ms]**	TBC	TBC	[99,999%]	**[99,999%]**	**[From low to 10 Mbps]**	[Small to big]	[Low]	[Low]	**TBC**

NOTE 1: Traffic prioritization and hosting services close to the end-user may be helpful in reaching the lowest latency values.
NOTE 2: Currently realised via wired communication lines.
NOTE 3: This is the end-to-end latency the service requires. The end-to-end latency is not completely allocated to the 5G system in case other networks are in the communication path.
NOTE 4: Communication service availability relates to the service interfaces, reliability relates to a given node. Reliability should be equal or higher than communication service availability.
NOTE 5: Small: payload typically ≤ 256 bytes
NOTE 6: Based on the assumption that all connected applications within the service volume require the user experienced data rate.
NOTE 7: Under the assumption of 100% 5G penetration.
NOTE 8 Estimates of maximum dimensions; the last figure is the vertical dimension.
NOTE 9: In dense urban areas.
NOTE 10: All the values in this table are targeted values and not strict requirements.

Criteria for Standards Development (CSD) – Draft

- 1.1 Project process requirements
- › ***1.1.1 Managed objects***
- *– Describe the plan for developing a definition of managed objects.*
- *The plan shall specify one of the following:*
  - *a) The definitions will be part of this project.*
  - *b) The definitions will be part of a different project and provide the plan for that project or anticipated future project.*
  - *c) The definitions will not be developed and explain why such definitions are not needed.*
- c) Definitions of new managed objects will not be required, because the proposed standard will specify profiles that define the use and configuration of functions defined in other IEEE 802 standards.

Criteria for Standards Development (CSD) – Draft

- › ***1.1.2 Coexistence***
- *– A WG proposing a wireless project shall demonstrate coexistence through the preparation of a Coexistence Assurance (CA) document unless it is not applicable.*
  - *a) Will the WG create a CA document as part of the WG balloting process as described in Clause 13? (yes/no)*
  - *b) If not, explain why the CA document is not applicable.*
- › A CA document is not applicable because this is not a wireless project; it provides wired infrastructure for a wireless cellular network.

Criteria for Standards Development (CSD) – Draft

- 1.2 5C requirements
- › ***1.2.1 Broad market potential***
- *– Each proposed IEEE 802 LMSC standard shall have broad market potential. At a minimum, address the following areas:*
  - *a) Broad sets of applicability.*
  - *b) Multiple vendors and numerous users.*
- a) Network partitioning enables the operator to create networks customized to provide solutions for different market scenarios with diverse latency requirements, e.g. uRLLC/eMBB/mMTC applications.
- b) Several vendors and operators have expressed their support for network slicing by IEEE 802.1 time-sensitive networks.

Criteria for Standards Development (CSD) – Draft

- ***1.2.2 Compatibility***
- *– Each proposed IEEE 802 LMSC standard should be in conformance with IEEE Std 802, IEEE 802.1AC, and IEEE 802.1Q. If any variances in conformance emerge, they shall be thoroughly disclosed and reviewed with*
- *IEEE 802.1 WG prior to submitting a PAR to the Sponsor.*
  - *a) Will the proposed standard comply with IEEE Std 802, IEEE Std 802.1AC and IEEE Std 802.1Q?*
  - *b) If the answer to a) is no, supply the response from the IEEE 802.1 WG.*
- *– The review and response is not required if the proposed standard is an amendment or revision to an existing standard for which it has been previously determined that compliance with the above IEEE 802 standards is not possible. In this case, the CSD statement shall state that this is the case.*
- a) Yes, the proposed standard will comply with IEEE Std 802, IEEE Std 802.1AC and IEEE Std 802.1Q.

Criteria for Standards Development (CSD) – Draft

- ***Distinct Identity***
- *– Each proposed IEEE 802 LMSC standard shall provide evidence of a distinct identity. Identify standards and standards projects with similar scopes and for each one describe why the proposed project is substantially different.*
- › There is no other 802 standard or approved project that specifies TSN profile for network slicing

Criteria for Standards Development (CSD) – Draft

- ***1.2.4 Technical Feasibility***
- *– Each proposed IEEE 802 LMSC standard shall provide evidence that the project is technically feasible within the time frame of the project. At a minimum, address the following items to demonstrate technical feasibility:*
    - *a) Demonstrated system feasibility.*
    - *b) Proven similar technology via testing, modeling, simulation, etc.*
- a) The proposed standard will specify profiles for the use of other IEEE 802 standards for which system feasibility has been demonstrated.
- b) The proposed standard will use other IEEE 802 standards for which the technology has been proven.

Criteria for Standards Development (CSD) – Draft

- ***1.2.5 Economic Feasibility***
- *– Each proposed IEEE 802 LMSC standard shall provide evidence of economic feasibility. Demonstrate, as far as can reasonably be estimated, the economic feasibility of the proposed project for its intended applications. Among the areas that may be addressed in the cost for performance analysis are the following:*
  - *a) Balanced costs (infrastructure versus attached stations).*
  - *b) Known cost factors.*
  - *c) Consideration of installation costs.*
  - *d) Consideration of operational costs (e.g., energy consumption).*
  - *e) Other areas, as appropriate.*

- a) The well-established balance between infrastructure and attached stations will not be changed by the proposed standard.
- b) The cost factors are known for the IEEE 802 standards that this specification builds upon.
- c) There are no incremental installation costs relative to the IEEE 802 standards that this specification builds upon.
- d) There are no incremental operational costs relative to the existing costs associated with the IEEE 802 standards that this specification builds upon. Furthermore, operational costs can be decreased by automatic procedures based on this
- specification versus manual configuration.
- e) No other areas have been identified.